Pacific Science (1974), Vol. 28, No. 2, p. 181–188
Printed in Great Britain

Actiniogeton sesere (Coelenterata, Actiniaria) in Hawaii[1]

DAPHNE FAUTIN DUNN[2]

ABSTRACT: A species of sea anemone found in shallow water areas of southern Kaneohe Bay, Oahu, but never before reported from Hawaii, is described. It is identified as *Actiniogeton sesere*, previously recorded and described from the Torres Straits (Haddon and Shackleton 1893).

HAWAII'S COELENTERATE FAUNA is poorly known and is in need of serious study. As I have discussed elsewhere (Dunn 1974), the single monographic treatment of shallow water anthozoans of Hawaii (Verrill 1928) is outdated, both because of taxonomic changes and because of new findings. In an earlier paper (Dunn 1974), I dealt with the former problem, redescribing a sea anemone that had been given a new specific and generic designation by Verrill, but that had previously been described from Ambon; here I redescribe a species that is not included in Verrill's work.

This description is based upon examination of over 50 specimens in the field, eight in aquaria, dissections of five, and histological sections of six others. Nematocyst measurements were made from five different animals.

Actiniogeton sesere (Haddon & Shackleton 1893: 126)

Actinioides sesere Haddon & Shackleton 1893: 126; *Actinioides sesere* Haddon 1898: 428; *Actiniogeton sesere* Carlgren 1949: 62.

Habitat

This actinian occurs attached to firm substrates, usually on pieces of dead coral, intertidally and in shallow water on sandy shores and reef flats.

Size

Its basal diameter is typically 15 to 20 mm, which is also the approximate height and oral disc diameter of fully expanded specimens (Fig. 1). The column is slightly smaller in diameter than either end. Columns of small specimens (about 10 mm in height, oral and basal disc diameters) may be proportionally narrower.

Base

The base is strongly adherent and usually more or less circular in outline. Insertions of at least the stronger mesenteries are visible through it. The basal musculature is well developed, with a fold on either side of each mesentery. These animals are capable of considerable movement.

Column

The column abuts directly on the oral disc so that there is hardly any fossa. Strongly adhesive verrucae, which are for the most part simple and suckerlike in form (Fig. 2), occur in longitudinal rows. The verrucae, the largest of which have a diameter of about 1 mm, are bright green and contrast with the column, which is white or gray in its lower third to half, and violet-brown above. At the top of each row of verrucae is a blunt digitiform marginal pseudospherule that is white but may have small dark spots and a green sheen. The pseudospherules are arranged in a single ring around the margin and are perforate so that jets of water can be emitted through them when the anemone contracts suddenly. Each pseudospherule and corresponding row of verrucae is endocoelic in position.

[1] This investigation was supported by NIH Fellowship 1 FO2 GM54232-01 from the Institute of General Medical Sciences. Manuscript received 1 June 1973.

[2] Department of Pharmacology, University of Hawaii School of Medicine, Leahi Hospital, 3675 Kilauea Avenue, Honolulu, Hawaii 96816. Present address: School of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia.

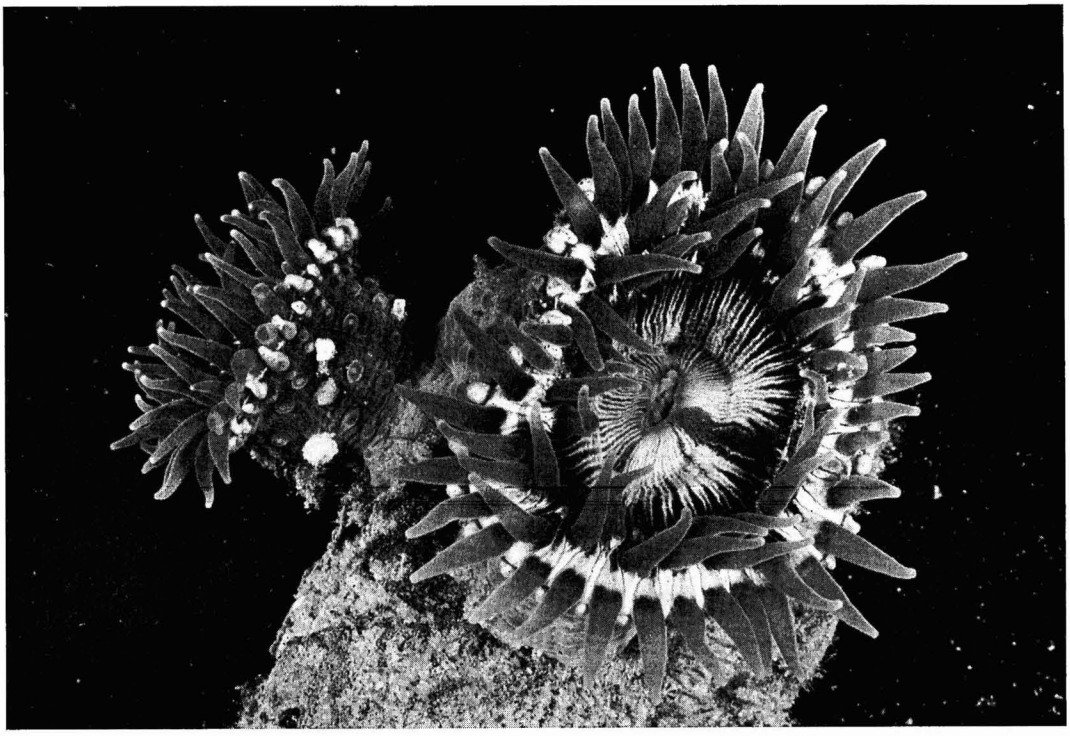

FIG. 1. Two expanded specimens of *Actiniogeton sesere*. Note especially the white, black-spotted pseudospherules, the rows of adhesive verrucae below them, and the patterning of the oral disc. (Photograph by S. Arthur Reed.)

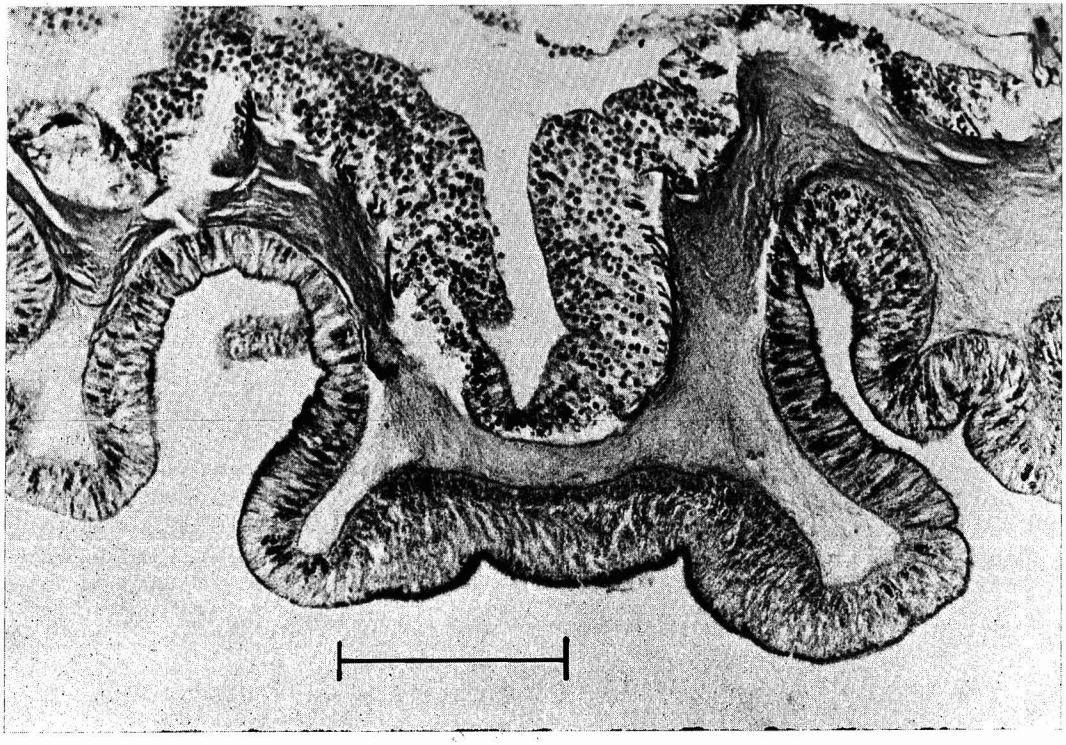

FIG. 2. Cross section through a verruca. Note the endodermal zooxanthellae. Scale is 200 μm.

Typically there are one to several small verrucae below each pseudospherule, followed by two to four very pronounced ones, below which are smaller ones, diminishing in size, and often in intensity of pigmentation, downward. Several of the rows of verrucae extend all the way to the base. There are also small vesicles in the lower part of the column.

When strongly contracted, the column become hemispherical, but usually a small tuft of tentacles is visible centrally. Such extreme contraction is unusual. The circular columnar musculature is endodermal.

Oral Disc

The lipless oval mouth (one specimen had two mouths, one central and a smaller one slightly to the side) is situated on a conical eminence surrounded by a slight depression, but the rest of the oral disc is flat. The area immediately around the mouth is bright green and this pigmentation may extend to the entire cone and even to the area surrounding it. White lines radiate from the cone, where they are densest, but most do not reach all the way to the margin. In some individuals the area bounded by two such lines is green. The ground color of the oral disc is brown, and mesenterial insertions may show through it as dark lines. More than half the diameter of the oral disc is free of tentacles.

Tentacles

The tentacles, which are arranged in several indistinct circles on the outer portion of the oral disc, are conical and pointed, and have perforate tips so that water may jet through them when the animal contracts suddenly. In each of two anemones, one tentacle was found to be bifurcate. All the tentacles of an individual are of approximately equal size, averaging 4 to 6 mm in length. One tentacle is located over each exocoel and endocoel so that there are twice as many tentacles as marginal pseudospherules. The number of tentacles is variable, ranging from 28 in an animal 12 mm across the oral disc, to 135 in a fairly large anemone, but the number averages around 96.

The color of all the tentacles is bright green, shading into brownish yellow. The white splotch that may be present at the base of each inner tentacle sometimes extends partway up the tentacle, in which case the tentacle has a dark longitudinal line on its oral face. In other individuals, the entire disc area from which the tentacles arise is white (Fig. 1). The green pigmentation of the oral disc, tentacles, and verrucae usually disappears in formalin-preserved specimens.

In cross section, the ectoderm and zooxanthellae-bearing endoderm are about equal in thickness, and the mesoglea is up to half the thickness of each of the other layers. The longitudinal tentacular musculature is ectodermal to meso-ectodermal, and the circular muscles are endodermal.

Mesenteries and Internal Anatomy

None of the four specimens examined in cross section had directive mesenteries, although the throat was pulled into three or four angles by the strongest pairs of mesenteries. In one animal the arrangement of gland cells and elongate cilia in such an angle gave it the appearance of a somewhat atypical siphonoglyph, but this was the only structure resembling a siphonoglyph in the four animals. The well-developed retractor muscles may consist of a series of more or less circumscribed lobes (Fig. 3). The mesogleal axis of each lobe branches into approximately a dozen processes. In other individuals, or occasionally other mesenteries of the same animal, each unbranched or sparsely branched mesogleal process arises directly from the main mesenteric mesogleal layer (Fig. 4). These laminae are equal in length to those arising from a single stem.

In an individual with 56 pairs of mesenteries, 18 were incomplete, and in another with 63 pairs, 17 were incomplete. The stronger mesenteries are always complete, and the number of mesenteries is the same at the two ends of the column. No fertile individuals were found. Tripartite mesenterial filaments are present on all but the very smallest mesenteries. There are large marginal stomata in the complete mesenteries, but no oral stomata could be detected. Zooxanthellae occur in the endoderm of both the column and the mesenteries, and decrease in

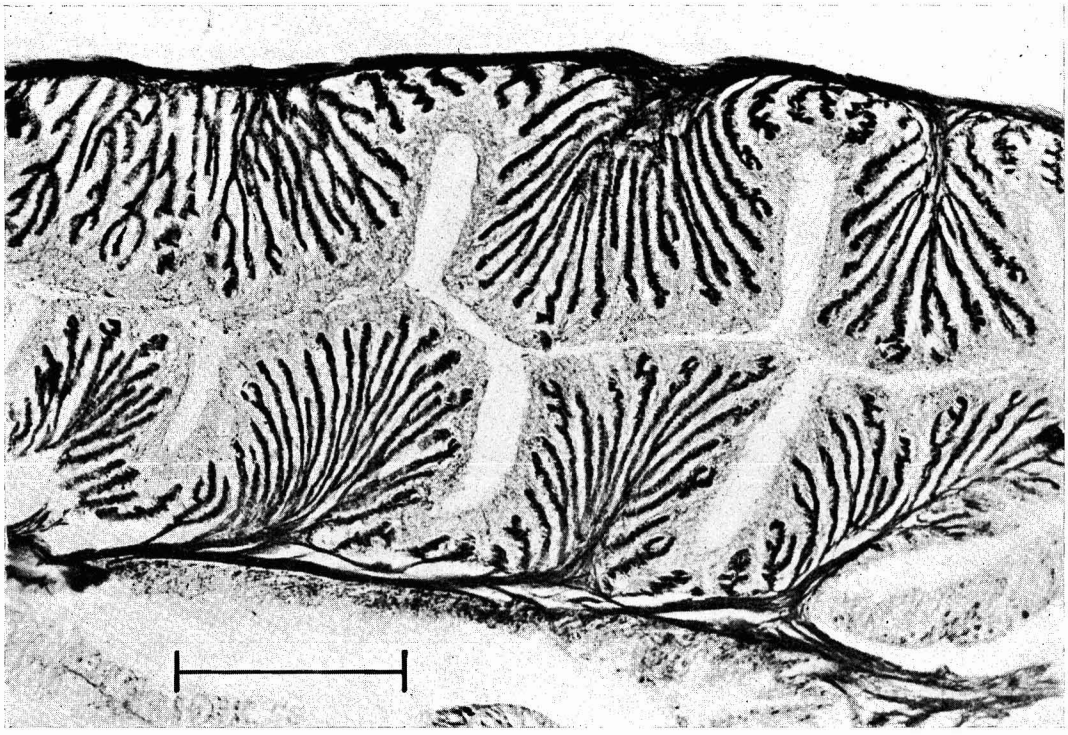

FIG. 3. Cross section of lobed retractor muscles. Scale is 200 μm.

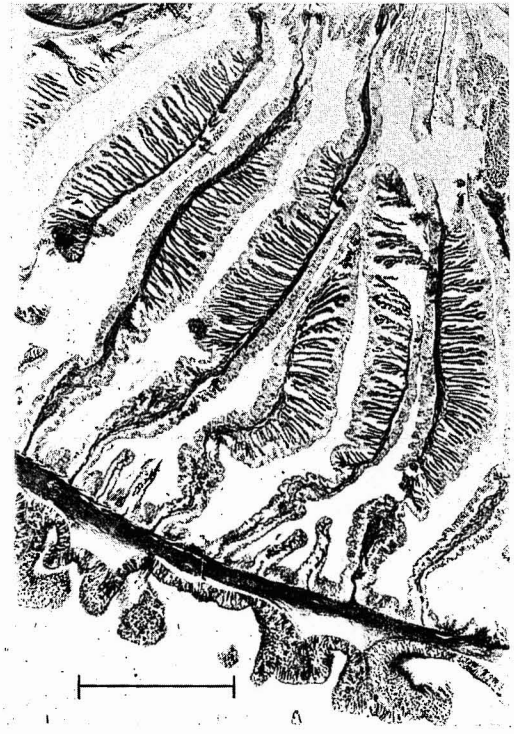

FIG. 4. Cross section through lower column of *Actiniogeton sesere*. Scale is 550 μm.

density basally. Parietobasilar muscles are not very well developed and have, at most, only a very narrow free flap just above the base along the stronger mesenteries.

The throat is whitish in color and is ribbed. It is one-half to three-quarters the length of the column. The ectoderm of the actinopharynx contains randomly spaced patches of glandular cells. Normally the endoderm is twice as thick as the mesoglea, and the ectoderm of the throat is twice the thickness of the endoderm, but the mesoglea is considerably thickened in the throat folds.

The three body layers are about equally thick in the column wall, but at the base the ectoderm is thickened to approximately four times the width of each of the other two layers.

The endodermal sphincter is oval in shape and fairly weak. It appears circumscribed (Fig. 5), but it may have a few very small subsidiary mesogleal laminae in addition to the main one. There may be more branches on one side of the axis than on the other. It is located just

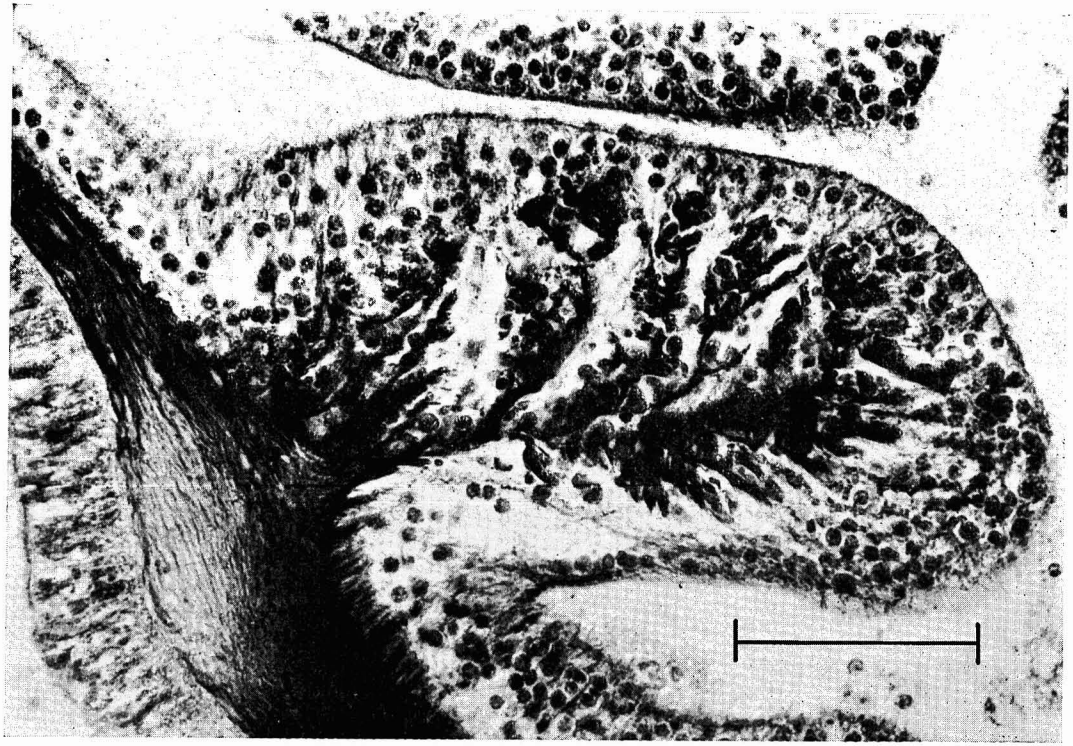

FIG. 5. Cross section of the sphincter of *Actiniogeton sesere*. Note the endodermal zooxanthellae. Scale is 95 μm.

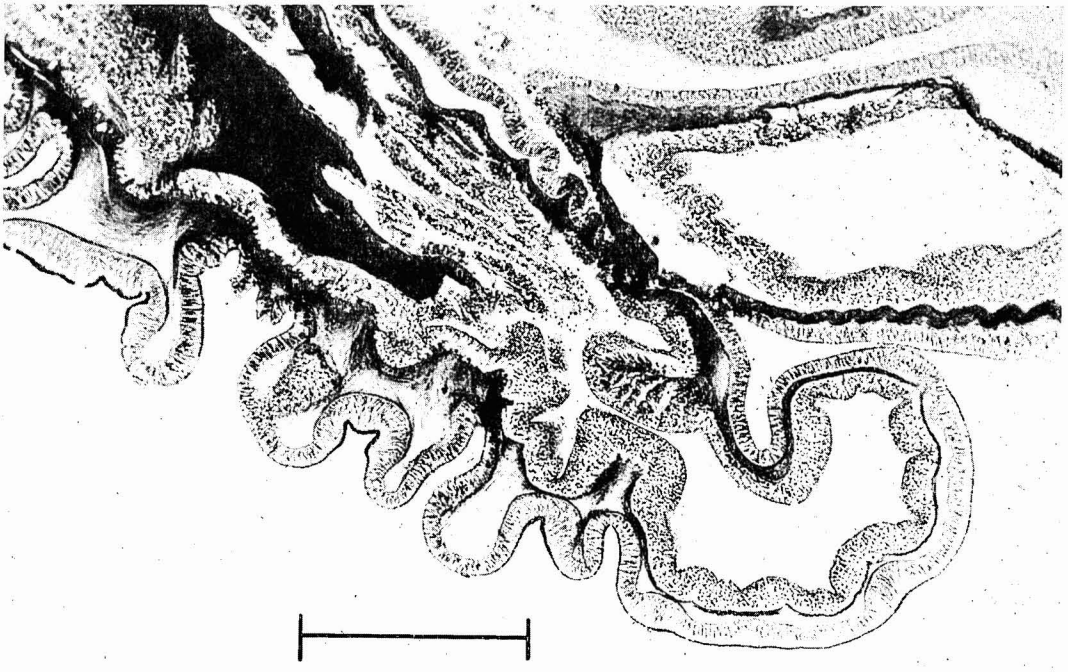

FIG. 6. Longitudinal section through an endocoel of *Actiniogeton sesere*, showing a pseudospherule and row of verrucae. Proximal to the pseudospherule, in the fossa, is the sphincter (in cross section). Scale is 500 μm.

proximal to the marginal pseudospherules at the bottom of the very shallow fossa.

Cnidom

Spirocysts, basitrichs, and microbasic p-mastigophores constitute the cnidom.

Distribution and Size of Nematocysts

TENTACLES: spirocysts, 11.4–24.3 × 2.4–4.6 μm (27); basitrichs, 14.3–22.4 × 1.9–3.3 μm (26).

MARGINAL PSEUDOSPHERULES: basitrichs, 14.3–17.1 × 1.9–3.1μm (29).

COLUMN: basitrichs, 13.4–18.8 × 2.0–3.4 μm (32); microbasic p-mastigophores (scarce), 21.4–28.1 × 5.1–7.4 μm (10).

ACTINOPHARYNX: spirocysts, 15.4–22.8 × 2.7–4.7 μm (23); basitrichs, 14.7–24.1 × 2.4–3.8 μm (24).

FILAMENTS: basitrichs, 10.7–17.4 × 2.0–3.8 μm (14); basitrichs (24.1) 27.5–34.8 × 2.7–4.0 μm (21); microbasic p-mastigophores, 22.8–26.8 × 4.0–5.4 μm (21).

Distribution

I have found this sea anemone on the sandy shores of Moku o Loe (Coconut Island) and on reef flats in the southern part of Kaneohe Bay, Oahu, but have failed to find it in similar habitats at the north end of the bay, on the shores below Diamond Head, and at several localities on the north and northeast shores of Oahu.

This species has been observed in aquaria to divide longitudinally. Its pedal disc elongates and division occurs across the shorter axis through the center of the body. This mode of reproduction probably accounts for its irregular anatomy and for its relative abundance in the few localities where I have seen it. Also in aquaria, some individuals move up the glass walls until they are partially out of the water. This position at the air-water interface corresponds to the species' natural habitat, for the animals occur on the surface or in holes of rocks that may be uncovered at low tide. These rocks are usually partly buried in sand so that the lower part of each anemone's column may be beneath the surface of the substrate. This probably explains the decreased density of zooxanthellae basally.

Discussion

Using Carlgren's (1949) key to sea anemones of the world, one may easily assign this species to the largest family of actinians, the Actiniidae, due to its possession of basilar muscles and of an endodermal sphincter, and by the arrangement of its tentacles and mesenteries. The marginal pseudospherules and columnar verrucae narrow the choice to the genus *Actiniogeton*. In all other respects except one this animal conforms to the description of that genus. The Hawaiian species has strong retractor muscles, whereas members of *Actiniogeton* are supposed to have weak ones. However, this is a quantitative rather than a qualitative difference, and *A. rapanuiensis*, listed by Carlgren (1949) as unequivocally belonging to *Actiniogeton*, also has strong retractors (Carlgren 1922).

All of the six species listed under *Actiniogeton* by Carlgren (1949) were originally described as belonging to the genus *Actinioides*. Four of these are sufficiently different from the Hawaiian species that they can be readily eliminated as possible identifications of it. *A. ambonensis*, listed with a query due to its lack of verrucae, has too diffuse a sphincter (Kwietniewski 1898). The sphincter of *A. papuensis*, its description being almost the only taxonomically useful information provided for the animal, is far too weak and diffuse (Haddon 1898). This species, too, is only questionably an *Actiniogeton*. The well-developed parietobasilar muscles and color of *A. spenceri*, which has a reddish column, white verrucae, and a yellow mouth, clearly distinguish it from the species in question (Haddon and Duerden 1896). Color, although often an unreliable systematic character in sea anemones (Stephenson 1928), is sufficiently constant and distinctive in the Hawaiian species to be of some taxonomic value. The sphincter of *A. rapanuiensis* is apparently quite variable, but all three variations figured by Carlgren (1922) clearly differ from that of the species in question. Moreover, Carlgren noted the presence of nematocysts with a spiral thread in the pseudospherules. If

this is indeed a type different from that for which he gave the dimensions, then some doubt must be cast upon the assignment of the species to *Actiniogeton*, for pseudospherules are supposed to contain only basitrichs (Carlgren 1949).

Both *A. sultana* (Carlgren 1900, 1938), the type species of the genus, and *A. sesere* (Haddon 1898, Haddon and Shackleton 1893) resemble the Hawaiian species in size, habitat, and general anatomy. *A. sesere* has a black dot at the base of its outer tentacles but, except for that, its coloration is identical to that of the Hawaiian species, and Haddon (1898) says of the former, "the general green colour and the bright green spots [verrucae] are very characteristic" (p. 428). The coloration of *A. sultana* is not very different, although its verrucae are "about the same color" (Carlgren 1938: 33) as the column, and its outer tentacles are white. No data are given for the nematocysts of *A. sesere*, but those of *A. sultana* (Carlgren 1938, 1945) are, with a few exceptions, of the same size range and distribution as those found in the Hawaiian species. Haddon (1898) and Haddon and Shackleton (1893) do not discuss the siphonoglyphs of *A. sesere*, but Carlgren (1938) found at least four in each of the six specimens of *A. sultana* he examined. The siphonoglyph figured by him (1938: 35) is much more typical morphologically than the single one I found in the species in question, and the mesenteries attached to it are considerably weaker. The sphincters of the two species are quite different. That of *A. sultana* is very weak and circumscribed. Haddon's (1898) comment on that of *A. sesere*, that "at first sight it looks as if it should be classed as circumscribed" (p. 428), could equally well describe the sphincter of the Hawaiian species, although it is not quite as diffuse as the one illustrated by Haddon (1898, plate 28). *A. sultana* has been recorded from South Africa and Zanzibar, and *A. sesere* is known from the Torres Straits.

On the basis of the forms of the siphonoglyphs, mesenteries, and sphincter, it is evident that the Hawaiian species of *Actiniogeton* is not *A. sultana*. Although the descriptions of *A. sesere* are brief, they agree with the species in question in nearly all respects. Therefore, the small greenish species of sea anemone found in southern Kaneohe Bay, Oahu, and not discussed by Verrill (1928), can, with reasonable certainty, be identified as *A. sesere*. One remaining question is whether this actinian has arrived in the islands only relatively recently, or whether it was overlooked or not recorded by Verrill.

ACKNOWLEDGMENTS

I wish to thank Dr. Ralph L. Bowers for first drawing my attention to *Actiniogeton sesere*, Dr. S. Arthur Reed for aiding with photography, and Mr. Heinz Hoben for translations from German. I acknowledge the use of facilities in the Departments of Pharmacology, Pathology, and Tropical Medicine/Medical Microbiology of the University of Hawaii School of Medicine, Leahi Hospital.

LITERATURE CITED

CARLGREN, O. 1900. Ostafrikanische Actinien. Mitt. naturh. Mus. Hamb. 17: 21–141.

———. 1922. Actiniaria und Zoantharia von Juan Fernandez und der Osterinsel. Pages 145–160 *in* C. Skottsberg, ed. The natural history of Juan Fernandez and Easter Island. Vol. 3 (zoology), part 2. Almqvist & Wiksells Boktryckeri Artiebolag, Uppsala.

———. 1938. South African Actiniaria and Zoantharia. K. svenska VetenskAkad. Handl., Tredje ser., 17(3): 1–148.

———. 1945. Further contribution to the knowledge of the cnidom in the Anthozoa, especially in the Actiniaria. Lunds Univ. Årsskr. (N.F.), ser. 2, 41(9): 1–24.

———. 1949. A survey of the Ptychodactiaria, Corallimorpharia and Actiniaria. K. svenska VetenskAkad. Handl., Fjärde ser., 1(1): 1–121.

DUNN, D. F. 1974. *Radianthus papillosa* (Coelenterata, Actiniaria) redescribed from Hawaii. Pacif. Sci. 28: 171–179.

HADDON, A. C. 1898. The Actiniaria of Torres Straits. Sci. Trans. R. Dublin Soc., ser. 2, 6: 393–520.

HADDON, A. C., and J. E. DUERDEN. 1896. On some Actiniaria from Australia and other districts. Sci. Trans. R. Dublin Soc. 6: 139–172.

HADDON, A. C., and A. M. SHACKLETON. 1893. Description of some new species of Actiniaria from Torres Straits. Sci. Proc. R. Dublin Soc. 8: 116–131.

KWIETNIEWSKI, C. R. 1898. Actiniaria von Ambon und Thursday Island. Pages 385–430 *in* R. Semon, ed. Zoologische Forschungsreisen in Australien und dem Malayischen Archipel. Vol. 5. Verlag von Gustav Fischer, Jena.

STEPHENSON, T. A. 1928. The British sea anemones. Vol. 1. Ray Society, London. 148 pp.

VERRILL, A. E. 1928. Hawaiian shallow water Anthozoa. Bull. Bishop Mus., Honolulu 49. 30 pp.